

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2004/001701

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC7:** H01L 21/027, G02B 26/00, G03F 7/20  
 According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC7: G02B, G03F, H01L**Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
**SE,DK,FI,NO classes as above**Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
**EPO-INTERNAL, WPI DATA, PAJ**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4970546 A (SUZUKI, K. ET AL), 13 November 1990 (13.11.1990), column 2, line 47 - line 52; column 3, line 1 - line 10, abstract	1,4
Y	--	3,5-24,26
Y	PATENT ABSTRACTS OF JAPAN Vol. 014, No. 374 (E0964) 13 August 1990 (1990-08-13) abstract & JP 02 135723 A (NIKON CORP) 24 May 1990 (1990-05-24) --	3,5-24,26

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"A" document defining the general state of the art which is not considered to be of particular relevance

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"E" earlier application or patent but published on or after the international filing date

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"Z" document member of the same patent family

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search

Date of mailing of the international search report

7 March 2005

11-03-2005

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## **INTERNATIONAL SEARCH REPORT**

**International application No.**

PCT/SE 2004/001701

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>PATENT ABSTRACTS OF JAPAN            Vol. 015, No. 430 (P1270)            31 October 1991 (1991-10-31)            abstract            &amp; JP 03 179357 A (NIKON CORP)            05 August 1991 (1991-08-05)</p> <p style="text-align: center;">--</p>	3,5-24,26
Y	<p>US 4822975 A (TORIGOE, M. ET AL), 18 April 1989            (18.04.1989), column 4, line 3 - line 36,            abstract</p> <p style="text-align: center;">-----</p>	3,5-24,26

INTERNATIONAL SEARCH REPORT  
Information on patent family members

30/01/2005

International application No.  
PCT/SE 2004/001701

US	4970546	A	13/11/1990	AU	612806 B	18/07/1991
				AU	3177889 A	05/10/1989
				DE	68909279 D, T	05/05/1994
				EP	0335229 A, B	04/10/1989
				JP	1257327 A	13/10/1989
				JP	2006368 U	17/01/1990
				JP	2569711 B	08/01/1997
				JP	6037480 Y	28/09/1994
				US	4977994 A	18/12/1990
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US	4822975	A	18/04/1989	JP	60127081 U	27/08/1985
				JP	60158449 A	19/08/1985
				JP	61280619 A	11/12/1986
				JP	62031705 U	25/02/1987

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE 2004/001701

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

## Remark on Protest

The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

Continuation of box III.

1(2)

Invention I: Claims 1-4 are directed to a method for patterning a work piece.

The solution of invention I is to determine the uniformity as a function of the number of exposure flashes.

Invention II: Claims 5-9 are directed to a method for printing a work piece.

The solution of invention II is to change a parameter of the exposure flashes per surface element on a layer-by-layer basis. The changed parameter is for example the number of flashes, the pulse length or the radiation bandwidth.

Invention III: Claims 10-17 are directed to a number of alternative procedures in a scanner or stepper. Some parts of claims 10-17 have special technical features linked with claims 1, 2-4, for example the changing of the parameters pulse length, number of flashes or laser bandwidth.

The solution of invention III is to provide a scanner system with an optical field larger than 10 mm and to increase one or more parameters to obtain a non-uniformity from speckle amounts less than 0.5%.

Invention IV: Claims 18-22 are directed to a procedure in a maskless scanner.

The solution of invention IV is to provide an optical field larger than 0.5 mm and to increase parameters, for example the laser bandwidth or the pulse length, in a maskless scanner system to obtain a speckle amount less than 0.5% and to provide a maskless scanner with an optical field larger than 0.5 mm.

Invention V: Claims 23 and 26 are directed to an apparatus for printing a work piece.

The solution of invention V is to calculate the speckle and to change the number of pulses per surface element.

Invention VI: Claim 24 is directed to a procedure for optimizing the speckle during microlithographic printing.

The solution of invention VI is to provide a model for the value of the improved CD uniformity, for the cost of printing with a particular number of pulses, to provide logic and resources to select a number of flashes and to provide a control adapted to change the number of flashes.

.../...

2 (2)

Continuation of box III.

All of these inventions alternate the number of flashes. However, there is no other technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

The search concerns the first invention mentioned but also includes all six inventions, I-VI.

From for instance US 4970546, an illumination control device which uses a minimum number of pulses required for substantially smoothing a speckle pattern is known. The invention as defined in the independent claims 1 and 4 differs from this technique in that the uniformity is determined for a plurality of layers. To use the arrangement from US 4970546, considered as the closest prior art, on several layers in a patterning process instead of on one layer is considered to be obvious for a person skilled in the art. Therefore, the technique mentioned in the independent claims 1 and 4 lacks an inventive step. Since the invention according to claims 1 and 4 lacks an inventive step, the remaining claims, 2 and 3, will consist of two separate inventions.

A posteriori, the separate inventions are:

Invention I:1: Claims 1-2 relate to a method for patterning a work piece with improved CD uniformity by selecting a combination of values of the radiation bandwidth, pulse length or radiation flash frequency so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

Invention I:2: Claim 3 relates to a method for patterning a work piece with improved CD uniformity by determining a value of a slit width so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

These inventions are not so linked à posteriori as to form one single general inventive concept (PCT Rule 13.1). There is no technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

The search of inventions I:1 and I:2 could be done without effort justifying an additional fee.

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>P00195PCT</b>	<b>FOR FURTHER ACTION</b>	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. <b>PCT/SE 2004/001701</b>	International filing date (day/month/year) <b>19 November 2004</b>	(Earliest) Priority Date (day/month/year) <b>20 November 2003</b>
Applicant <b>Micronic Laser Systems AB, IPR &amp; Legal Department et al</b>		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 6 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report
  - a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 

The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
  - b.  With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.
2.  Certain claims were found unsearchable (see Box No. II):
3.  Unity of invention is lacking (see Box No. III)
4. With regard to the title,
  - the text is approved as submitted by the applicant.
  - the text has been established by this Authority to read as follows:
5. With regard to the abstract,
  - the text is approved as submitted by the applicant.
  - the text has been established; according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
  - a. the figure of the drawings to be published with the abstract is Figure No. 6
    - as suggested by the applicant.
    - as selected by this Authority, because the applicant failed to suggest a figure.
    - as selected by this Authority, because this figure better characterizes the invention.
  - b.  none of the figures is to be published with the abstract.

## INTERNATIONAL SEARCH REPORT

International application No.  
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## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

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See extra sheet.

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
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4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

## Remark on Protest

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

1(2)

Continuation of box III.

Invention I: Claims 1-4 are directed to a method for patterning a work piece.

The solution of invention I is to determine the uniformity as a function of the number of exposure flashes.

Invention II: Claims 5-9 are directed to a method for printing a work piece.

The solution of invention II is to change a parameter of the exposure flashes per surface element on a layer-by-layer basis. The changed parameter is for example the number of flashes, the pulse length or the radiation bandwidth.

Invention III: Claims 10-17 are directed to a number of alternative procedures in a scanner or stepper. Some parts of claims 10-17 have special technical features linked with claims 1, 2-4, for example the changing of the parameters pulse length, number of flashes or laser bandwidth.

The solution of invention III is to provide a scanner system with an optical field larger than 10 mm and to increase one or more parameters to obtain a non-uniformity from speckle amounts less than 0.5%.

Invention IV: Claims 18-22 are directed to a procedure in a maskless scanner.

The solution of invention IV is to provide an optical field larger than 0.5 mm and to increase parameters, for example the laser bandwidth or the pulse length, in a maskless scanner system to obtain a speckle amount less than 0.5% and to provide a maskless scanner with an optical field larger than 0.5 mm.

Invention V: Claims 23 and 26 are directed to an apparatus for printing a work piece.

The solution of invention V is to calculate the speckle and to change the number of pulses per surface element.

Invention VI: Claim 24 is directed to a procedure for optimizing the speckle during microlithographic printing.

The solution of invention VI is to provide a model for the value of the improved CD uniformity, for the cost of printing with a particular number of pulses, to provide logic and resources to select a number of flashes and to provide a control adapted to change the number of flashes.

.../...

Continuation of box III.

2(2)

All of these inventions alternate the number of flashes. However, there is no other technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

The search concerns the first invention mentioned but also includes all six inventions, I-VI.

From for instance US 4970546, an illumination control device which uses a minimum number of pulses required for substantially smoothing a speckle pattern is known. The invention as defined in the independent claims 1 and 4 differs from this technique in that the uniformity is determined for a plurality of layers. To use the arrangement from US 4970546, considered as the closest prior art, on several layers in a patterning process instead of on one layer is considered to be obvious for a person skilled in the art. Therefore, the technique mentioned in the independent claims 1 and 4 lacks an inventive step. Since the invention according to claims 1 and 4 lacks an inventive step, the remaining claims, 2 and 3, will consist of two separate inventions.

A posteriori, the separate inventions are:

Invention I:1: Claims 1-2 relate to a method for patterning a work piece with improved CD uniformity by selecting a combination of values of the radiation bandwidth, pulse length or radiation flash frequency so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

Invention I:2: Claim 3 relates to a method for patterning a work piece with improved CD uniformity by determining a value of a slit width so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

These inventions are not so linked à posteriori as to form one single general inventive concept (PCT Rule 13.1). There is no technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

The search of inventions I:1 and I:2 could be done without effort justifying an additional fee.

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 According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC7: G02B, G03F, H01L**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL, WPI DATA, PAJ**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4970546 A (SUZUKI, K. ET AL), 13 November 1990 (13.11.1990), column 2, line 47 - line 52; column 3, line 1 - line 10, abstract	1,4
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 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"B" earlier application or patent but published on or after the international filing date	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
**7 March 2005**Date of mailing of the international search report  
**11-03-2005**Name and mailing address of the ISA/  
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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2004/001701

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN Vol. 015, No. 430 (P1270) 31 October 1991 (1991-10-31) abstract & JP 03 179357 A (NIKON CORP) 05 August 1991 (1991-08-05)  --	3,5-24,26
Y	US 4822975 A (TORIGOE, M. ET AL), 18 April 1989 (18.04.1989), column 4, line 3 - line 36, abstract  -----	3,5-24,26

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

30/01/2005

International application No.

PCT/SE 2004/001701

US	4970546	A	13/11/1990	AU	612806	B	18/07/1991
				AU	3177889	A	05/10/1989
				DE	68909279	D,T	05/05/1994
				EP	0335229	A,B	04/10/1989
				JP	1257327	A	13/10/1989
				JP	2006368	U	17/01/1990
				JP	2569711	B	08/01/1997
				JP	6037480	Y	28/09/1994
				US	4977994	A	18/12/1990
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				JP	60127081	U	27/08/1985
				JP	60158449	A	19/08/1985
				JP	61280619	A	11/12/1986
				JP	62031705	U	25/02/1987